
Space Weather Technical Forecast

Issued on Monday, 13 March 2023 at 01:07 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: No Significant Activity.**Analysis of Space Weather Activity over past 24 hours**

Solar Activity: Low with only isolated C-flares. Peak flare was a C3.2 at 12/0719 UTC from AR3253 Bxo/Beta, located in the southeast quadrant. There are eleven sunspot regions on the visible disc, however these are generally small, simple and mature, with very little significant growth evident. A filament eruption was observed on the southeast disc, with an associated ribbon-separation evident in H-alpha GONG and SDO imagery. This has produced a CME which has been observed in imagery off the south-centre disc and on the Earth-Sun line, although likely directed southward. Further analysis is required to assess if there is any Earth-directed material.

Solar Wind / Geomagnetic Activity: Generally slow wind conditions have been observed, but with a potential weak passing transient. Solar wind speeds were mainly around 350-400 km/s. These were initially rather turbulent, before briefly peaking at near 430 km/s around 12/0900 UTC. The wind then eased and changed behaviour, with a more laminar flow following. Density was also initially below average but rapidly climbed to peak above average at 15 ppcc at the same time, before gradually easing towards background. The total IMF strength was predominantly weak but increased to Moderate between 12/0600-0900 UTC, peaking around 9 nT before also easing to background again thereafter. The north-south component was initially weak and variable, before a period of more sustained negative (southward) values occurred between 12/0600-0900U TC peaking -8 nT. This then rotated to be more stable and persistently weakly positive (northward) thereafter. Phi angle was negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 remained at background levels. High energy electron flux (greater than 2MeV) has been at moderate to background levels, with a peak of 726pfu at 12/0000 UTC. The associated 24 hour Electron fluence has remained below Active and declining. At 13/0000UTC the observed fluence was 1.36e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain generally Low with isolated C-class flares and a very slight chance of M-flares.

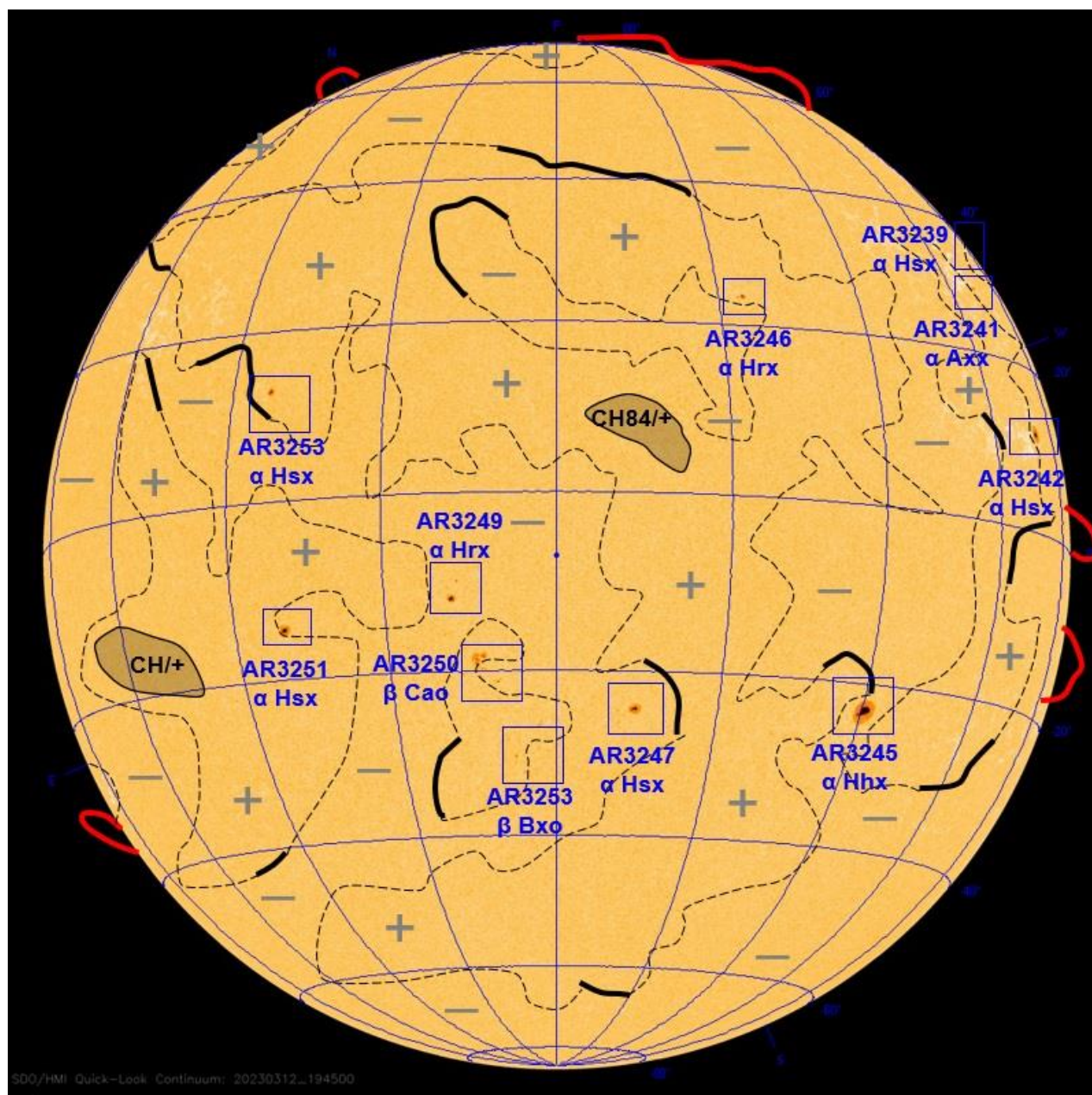
Solar Wind / Geomagnetic Activity: CME from the 10th may pass close enough to Earth to give some glancing influence on day 3 (15th), but this is low confidence. CME from the filament eruption on the 12th requires further analysis but has the potential for an Earth-directed component. Slow wind conditions with background speeds are expected day 1 and 2 (13th and 14th). CH84/+ HSS, preceded by any associated CIR, is then expected day 3 (15th) however, any enhancement is likely to be limited, with peak wind speeds 400-500km/s forecast. Geomagnetic activity is forecast to be mainly Quiet with isolated Unsettled intervals. This rising to Unsettled with a chance of Active intervals on day 3 (15th) from either CH or CME influence.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux, as

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observed by GOES16, is currently at background levels and expected to remain at this level. High energy electron flux levels (greater than 2MeV) are expected to be at Background to Moderate, with the associated 24 hour fluence expected to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 12/2000 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

The CME associated with a filament eruption off the southwest quadrant on the 10th may pass close enough to Earth to give some glancing influence on day 3 (15th), but this is low confidence. A further filament eruption from the southeast disc on the 12th has also produced an associated CME. Further analysis is required at this time to assess for any Earth-directed component.

Solar winds are expected to remain within a slow wind environment with mainly background speeds day 1 and day 2 (13th and 14th). A transition into fast wind environment is then expected day 3 (15th) due to the arrival of the high speed stream (HSS) of CH84/+. MOSWOC Enlil is currently considered a good guide to expected conditions, with any enhancement relatively muted. This gives a peak of slightly elevated solar winds at around 400-500 km/s.

Geomagnetic activity is likely to be mostly Quiet with isolated Unsettled intervals (Kp 0-3) day 1 and 2 (13th and 14th), increasing to Unsettled with a chance of isolated Active by Day 3 (15th), before easing back to Quiet, isolated Unsettled later day 4 (16th).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	5	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
10/1600	Partial	Filament	SW disc	410 km/s	Missing	Glance possible on 15th

Figure 1a: Enlil and ensemble showing potential for slight glance on 15th

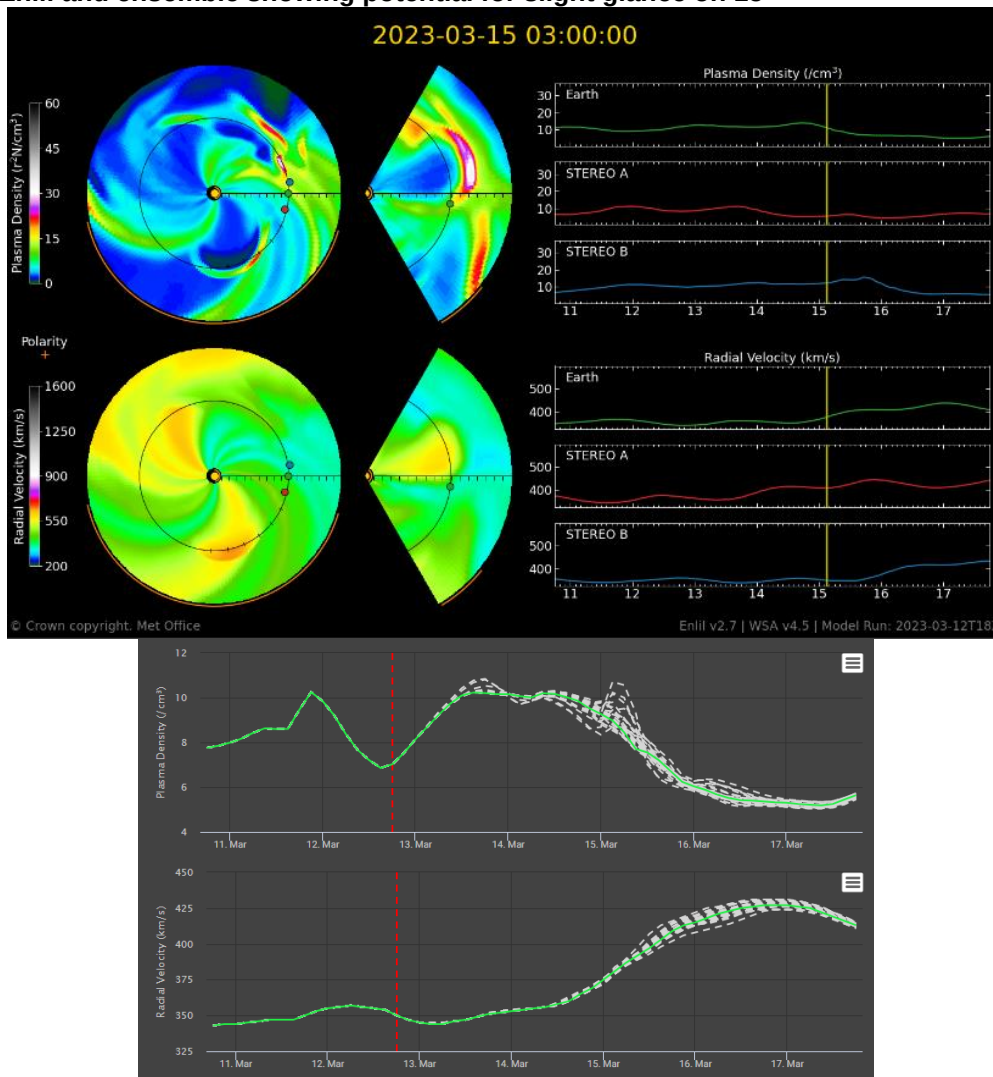
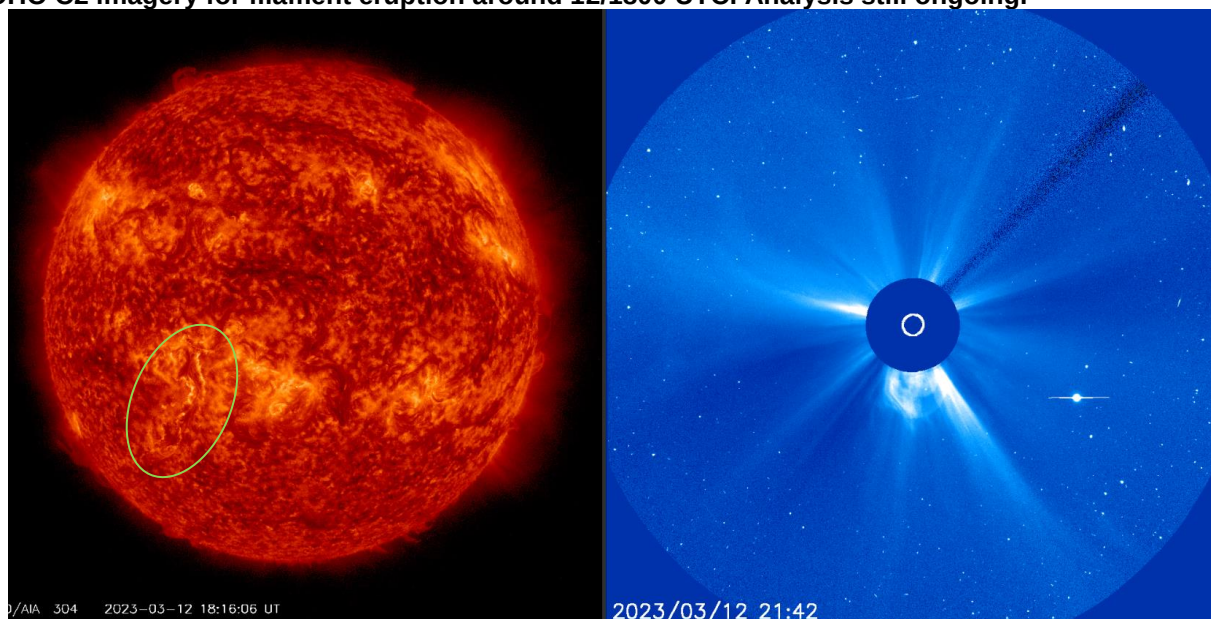


Figure 1b: Two ribbon filament channel in SDO aia-304 (left) and associated southward CME on SOHO C2 imagery for filament eruption around 12/1800 UTC. Analysis still ongoing.



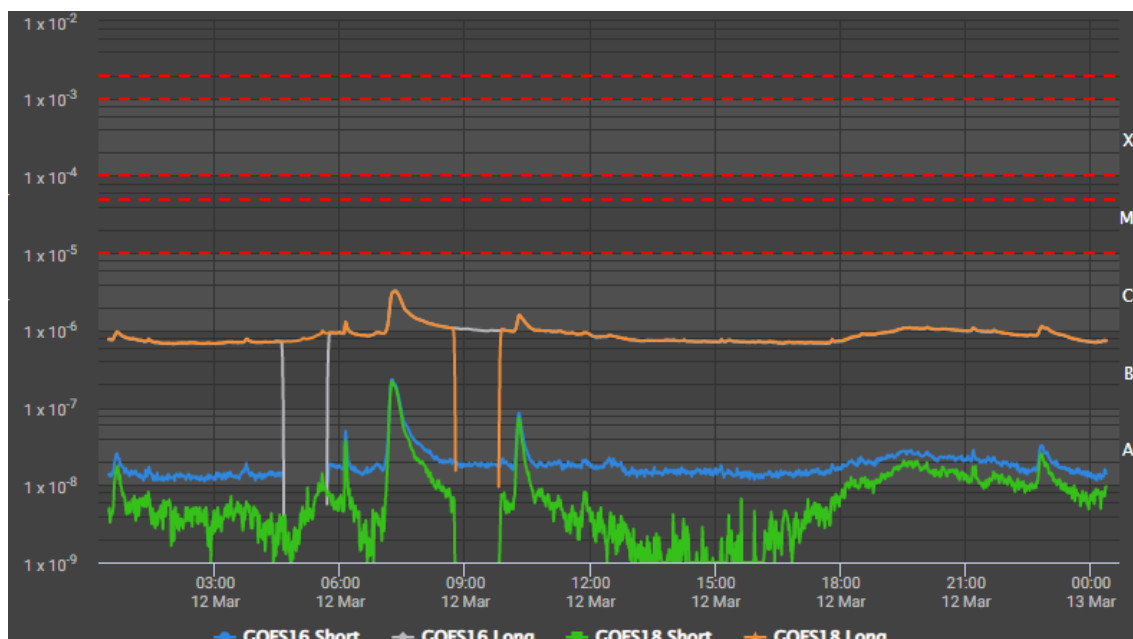
Radio Blackouts - X-Ray Flares:

Low activity is expected, with only a very slight chance of M-flares. There are eleven sunspot regions on the Earth-facing disc, however these are mainly mature unipolar regions. The majority of these are stable, with some declining. The largest of these regions, AR3245 Hlx/Beta brings perhaps the greatest flare risk from any of these. The only two bipolar regions both remain small and relatively indistinct, although AR3253 Bxo/Beta was the source of the largest C-flare in the last 24 hours.

The most likely source of any activity would potentially be from any filament lifts that occur, with a number of these features across the Earth-facing disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16/18 X-ray flux



Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux, as observed by GOES16, is currently at background levels, and is expected to remain at this level given the lack of significant active regions currently on the Earth-facing disc.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	1	1	1	1
Very Active	$\geq \text{S3}^*$	No	1	1	1	1

* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy (greater than 2 MeV) electron flux at GEO, as observed by GOES-16, is expected to persist at Background to Moderate levels. Any arrival of fast wind from CH84/+ is likely to drop electron fluxed further, to mainly background. With only a weak connection expected to the HSS from this feature, flux levels are likely to then persist at mainly background, perhaps rising to Moderate by the end of the period.

The associated 24 hour electron fluence is expected persist at below the Active level and likely declining. REFM is currently giving a good guide to expected conditions before any solar wind enhancement from CH84/+ HSS occurs.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	5
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 4: GOES-16 >2 MeV Electron Flux and Fluence with REFM

